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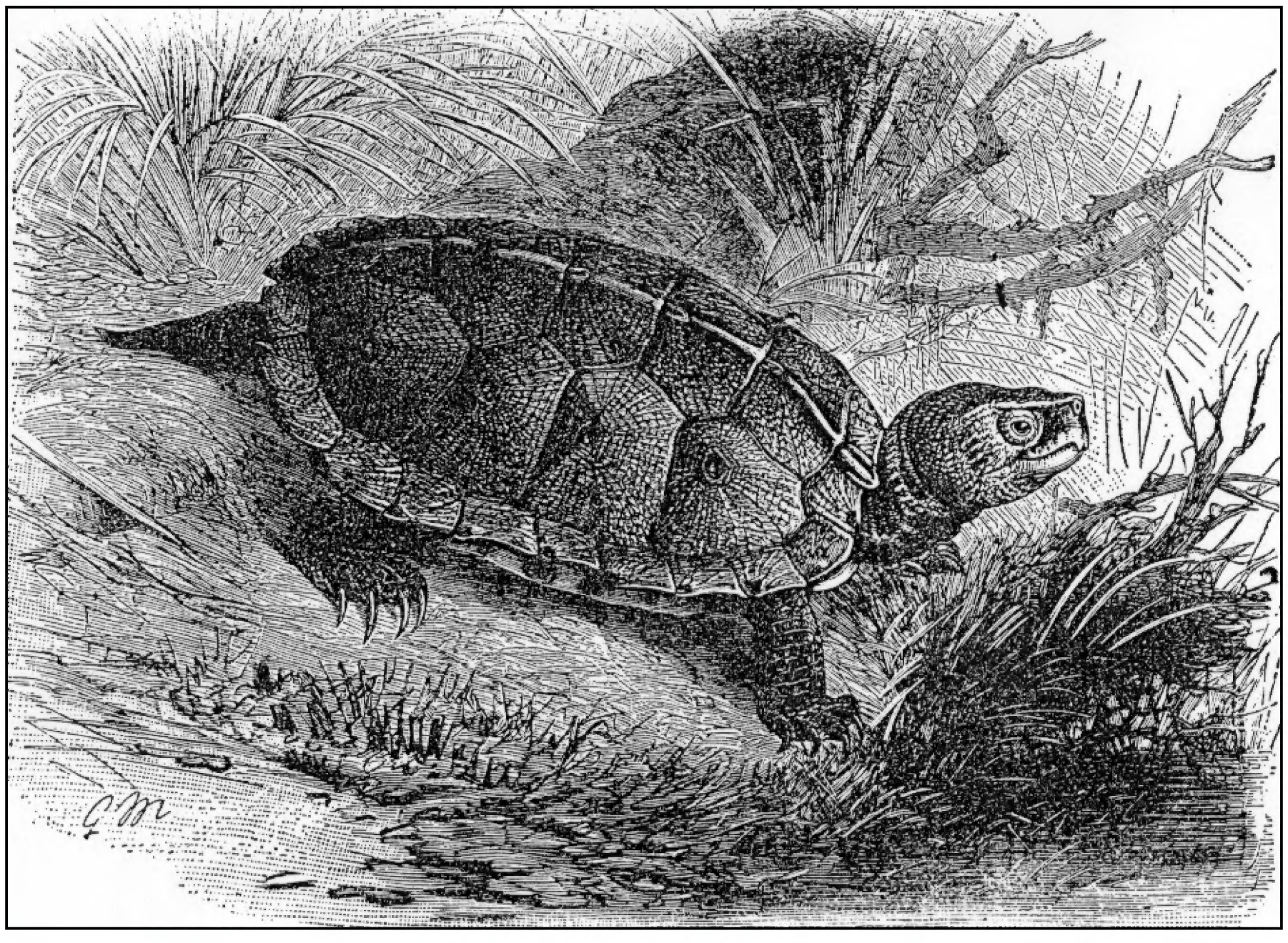

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Freshwater and Terrestrial Turtles of the United States: Status and Prognosis

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The United States, with 47 freshwater and three terrestrial turtles, has one of the most diverse turtle faunas in the world. All species found in Canada also occur in the United States. Our turtle fauna is particularly rich in emydid species (31, 32 if one considers *Graptemys kohnii* a full species). This species richness is due in large part to our many endemic, or practically endemic, genera, including the emydines *Chrysemys*, *Clemmys*, *Deirochelys*, *Emydoidea*, *Graptemys*, *Malaclemys*, and *Pseudemys*, the alligator snapping turtle, *Macroclemys temminckii*, the kinosternid musk turtles, *Sternotherus*, and the terrestrial tortoises of the genus *Gopherus*. The mud turtle genus *Kinosternon*, which originated in either Mexico or Central America, has contributed five species, as has also the softshell turtle genus of Asian origin, *Trionyx*, sensu Webb (1990), [two of which have been introduced into Hawaii (Webb, 1980; McKeown and Webb, 1982)]. The Upper Midwest has four families (Chelydridae, Kinosternidae, Trionychidae, and Emydidae), and 20 native species (Conant and Collins, 1991; Ernst et al., 1994).

Our turtles are, however, a troubled lot. Thirteen of the 56 species (23.2%) found north of Mexico are listed as either threatened or endangered under the federal Endangered Species Act (Table 1), and several other species are under consideration as candidates for federal protection or are already protected by some states within their ranges. We as concerned conservationists are responsible for preserving not only the overall turtle diversity, but also many of the individual species which are experiencing difficulty in maintaining their populations. The factors adversely affecting turtle populations are several, and they vary between species and even populations within species.

Two species of snapping turtles (Chelydridae) inhabit the United States. The alligator snapping turtle, *Macroclemys temminckii*, which reaches the Upper Midwest via the Mississippi and Ohio rivers, is our largest freshwater turtle (carapace length to 80 cm) and sometimes reaches a weight of over 100 kg. It is a deep water, riverine species seldom seen on shore. Unfortunately, the populations of this southeastern species were severely decimated for soup stock by trappers associated with a large commercial soup company which paid by the pound (Pritchard, 1989; Al Redmond, Dawson, Georgia, pers. com.). It has been protected by several states and is under consideration for listing under the Endangered Species Act by the United States Fish & Wildlife Service (USFWS). The common snapping turtle, *Chelydra serpentina*, is one of our most widely distributed turtles, both in the United States and the northcentral states. Due to its habitat plasticity, it often seems like the "cockroach" of the turtle world and can be found living in almost any type of waterbody from small woodland pools and muddy puddles in pastures to large rivers and deep lakes. It is only locally threatened by draining of its waterbodies and nest predation (primarily by raccoons), but many are lost to commercial trappers each year. However, a more sinister threat has been discovered in some northeastern populations that may not only affect *Chelydra serpentina* but other turtle species and humans as well. This is the presence of the chemical toxicants PCBs, dioxins and furans within its eggs, fat and liver tissue (Stone et al., 1980; Olafsson et al., 1983; Ryan et al., 1986; Bryan et al., 1987; Bishop et al., 1991); indication of the poor quality of many of our waterways.

Populations of five members of the Kinosternidae seem threatened, but for different reasons. The flattened musk turtle, *Sternotherus depressus*, resides only in the Warrior/Alabama watershed of central Alabama where it has experienced a decline because of habitat degradation by logging and surface mining, commercial collecting for the pet trade and disease (Dodd, 1988, 1990). Despite evidence that the range of *S. depressus* extends farther west than formerly thought (Ernst et al., 1988), the species is federally protected as threatened under the Endangered Species Act (Table 1). The Alabama flattened musk turtle feeds heavily on the introduced Asian clam, *Corbicula manilensis* (Marion et al., 1991), and establishment of this mollusk may actually have benefited the turtle by providing an alternate food source. The Florida mud turtle, *Kinosternon subrubrum steindachneri*, of southern Florida, may be declining because of shrinking habitat due to diversion of waters normally flowing southward from Lake Okeechobee and the constant spread of commercial and housing developments. The population of the striped mud turtle, *Kinosternon baurii*, residing on Florida's Lower Keys is small and endangered (Dunson, 1992). Populations of the yellow mud turtle, *Kinosternon flavescens flavescens* (formerly known as the subspecies *spooneri*) in Illinois, eastern Iowa, and northeastern Missouri have also declined because of habitat shrinkage and these populations are now protected in those states. The United States population of the Big Bend mud turtle, *Kinosternon hirtipes murrayi*, is restricted to only a few cattle ponds, and, as such, is extremely vulnerable.

Two other kinosternid species occur in the Upper Midwest. The eastern mud turtle, *Kinosternon subrubrum subrubrum*, occurs only in the Ohio River drainages in southern Illinois and Indiana and as an isolated population in northwestern Indiana. The stinkpot or common musk turtle, *Sternotherus odoratus*, is much more widely distributed, and appears not to be greatly threatened. However, both species reach or approach their northern limits in the region and are subject to the natural stresses that limit the distributional range of their species.

There is a lack of data concerning the status of softshell turtles, family Trionychidae, in the United States, but surely they are facing the same stresses as their freshwater hard-

Table 1. North American turtles in need of protection (E = endangered; T = threatened; C = candidate species, more data needed; Date = federal listing under the Endangered Species Act).

Taxon (Common Name)	Status (Date)	Problems
Chelydridae		
Macroclemys temminckii (Alligator snapping turtle)	C	Low population size (?); apparently declining
Kinosternidae		
Kinosternon baurii (Striped mud turtle)	C	Lower Keys population declining
Kinosternon flavescens (Yellow mud turtle)	C	Specific populations in Illinois, Iowa and Missouri are declining
Kinosternon hirtipes murrayi (Big Bend mud turtle)	C	Vulnerable due to low population numbers and restricted habitat
Kinosternon subrubrum steindachneri (Florida mud turtle)	C	Declining in southern Florida
Sternotherus depressus (Flattened musk turtle)	T (1987)	Declining in the Black Warrior River upstream from Bankhead Dam
Trionychidae		
Trionyx sinensis (Chinese softshell)	C	Hawaii, apparent low populations affected by water pollution
Trionyx spiniferus (Spiny softshell)	C	International trade (?)
Trionyx steindachneri (Wattle-necked softshell)	C	Hawaii, apparent low populations affected by water pollution
Emydidae		
Clemmys guttata (Spotted turtle)	C	Declining due to habitat destruction, pet trade
Clemmys insculpta (Wood turtle)	C	Declining due to habitat destruction, pet trade
Clemmys marmorata (Western pond turtle)	C	Declining due to habitat destruction, pet trade and disease
Clemmys muhlenbergii (Bog turtle)	C	Declining due to habitat destruction, pet trade
Emydoidea blandingii (Blanding's turtle)	C	Declining due to habitat destruction
Graptemys barbouri (Barbour's map turtle)	C	Disease in Flint River, Georgia
Graptemys caglei (Cagle's map turtle)	C	Possibly declining
Graptemys flavimaculata (Yellow-blotched map turtle)	T (1991)	Declining
Graptemys oculifera (Ringed map turtle)	T (1986)	Declining
Malaclemys terrapin (Diamondback terrapin)	C	Decline in some populations due to habitat modification, overharvesting and drowning in crabpots
Pseudemys alabamensis (Alabama red-bellied turtle)	E (1987)	Entire population small and vulnerable
Pseudemys concinna (River cooter)	C	Disease in Flint River, Georgia
Pseudemys rubiventris (Red-bellied turtle)	E (1980)	Massachusetts populations small and vulnerable

Table 1 (cont'd). North American turtles in need of protection (E = endangered; T = threatened; C = candidate species, more data needed; Date = federal listing under the Endangered Species Act).

Taxon (Common Name)	Status (Date)	Problems
Emydidae (cont'd)		
Terrapene carolina (Eastern box turtle)	C	International trade and habitat destruction
Terrapene ornata (Ornate box turtle)	C	International trade and habitat destruction
Trachemys scripta (Slider)	C	International trade and habitat destruction
Testudinidae		
Gopherus agassizii (Desert tortoise)	T (1980)	Commercial trade, habitat modification, disease
Gopherus berlandieri (Texas tortoise)	C	Commercial trade, some habitat modification
Gopherus polyphemus (Gopher tortoise)	T (1987)	Commercial trade, habitat destruction, disease (?)
Cheloniidae		
Caretta caretta (Loggerhead)	T (1978)	Habitat modification, trawlers' nets, poaching (?)
Chelonia mydas (Green sea turtle)	E (1978)	Habitat modification, trawlers' nets, poaching
Eretmochelys imbricata (Hawksbill)	E (1970)	Habitat modification, poaching
Lepidochelys kempii (Kemp's ridley)	E (1970)	Habitat modification, trawlers' nets
Lepidochelys olivacea (Olive ridley)	E (1978)	Habitat modification, poaching
Dermochelyidae		
Dermochelys coriacea (Leatherback)	E (1970)	Habitat modification, poaching, ingestion of plastic bags

shelled counterparts. Hawaiian populations of the introduced Chinese softshell, *Trionyx sinensis*, and wattle-necked softshell, *Trionyx steindachneri*, are apparently small, and water pollution may be a major stress there. The spiny softshell, *Trionyx spiniferus*, and the smooth softshell, *Trionyx muticus*, both inhabit the Upper Midwest, and both are widespread in the Missouri, Mississippi and Ohio river watersheds. Lovich (1995) expressed concern that *T. spiniferus* may be adversely affected by the international pet trade. Status of the populations of both species in the northcentral states should be determined.

Many of the current turtle conservation problems in the United States involve species in the family Emydidae, some of which have limited geographical ranges, particularly some of the southern species of map turtles, genus *Graptemys*, that are restricted to single river systems. Also, map turtles are notoriously hard to catch in numbers, so assessing life history data and estimating population numbers become problematic. Currently, the yellow-blotched map turtle, *Graptemys flavimaculata*, and the ringed map turtle, *Graptemys oculifera*, are federally listed as threatened species, and Barbour's and Cagle's map turtles (*Graptemys barbouri* and *G. caglei*, respectively) are under consideration for listing. Map turtles face local problems, such as pesticide poisoning from cropland runoff and chemical pollution from fertilizer, pulp and paper mills (which often adversely affect their molluscan food sources; although widespread introduction of the Asiatic clam, *Corbicula manilensis*, may have increased the number of prey species), but have also been decimated by commercial collectors for the pet trade (Muir, 1984). Three map turtles reside in the northcentral United States, primarily associated with the larger rivers: the common map turtle, *G. geographica*; the false map turtle, *G. pseudogeographica* (including both subspecies, *G. p. pseudogeographica* and *G. p. kohnii*); and the Ouachita map turtle, *G. ouachitensis*. All three seem to be holding their own, but should be closely monitored.

The brackish coastal waters inhabited by diamondback terrapin, *Malaclemys terrapin*, represent a unique niche among North American emydid turtles. While some other species will occasionally enter brackish waters or even have a few populations living in them, *Malaclemys* depends almost exclusively on them, feeding, mating, and hibernating there. Its range extends along the Atlantic and Gulf coasts from Cape Cod, Massachusetts to Texas. Commercial trapping (not as severe as in the past, but still occurring), development of coastal wetlands and nesting beaches, pollution, loss of molluscan and decapod prey species, entrapment and subsequent drowning in commercial crabpots, and raccoon predation on nests have all contributed to a general decline in numbers of the species, with certain populations more affected than others. Some populations are considered candidates for federal listing.

Probably the most endangered freshwater turtle in the United States is the Alabama red-bellied turtle, *Pseudemys alabamensis*. It is found only in freshwater tributaries of Mobile Bay in Baldwin and Mobile counties, Alabama, and nests almost exclusively on Gravine Island, Baldwin County, which is subject to damage by oil spills and other pollution, flooding, and hurricanes (Dobie and Bagley, 1988). Nest predators are also a problem. Should the nesting habitat on this island be severely degraded or destroyed, the entire population would essentially be lost. Recent illegal collection of adult females has also occurred. *Pseudemys alabamensis* is now listed as endangered under the federal Endangered Species Act. New England populations of the red-bellied turtle, *Pseudemys rubriventris*, are also considered endangered by the USFWS and are federally protected (Table 1). The status and biology of the Rio Grande cooter, *P. gorzugi*, are yet to be determined.

The river cooter, *Pseudemys concinna*, barely reaches the Upper Midwest in southern Illinois and extreme southwestern Indiana. It does not seem to be in any danger at the moment, although individuals in the Flint River, Georgia are experiencing a necrotic disease involving severe degradation of the shell (Lovich et al., in press). Neither is the widely distributed painted turtle, *Chrysemys picta*, declining nationally. It is our only turtle species that ranges entirely across North America from the Atlantic Coast to the Pacific Coast.

The slider, *Trachemys scripta*, presents a unique problem for conservation. While still relatively widespread in large populations, hundreds of thousands of both adults and juveniles of this species have been shipped to Europe and Japan in recent years to satisfy pet trade and food demands. No slow maturing species, such as a turtle, can withstand this kind of cropping for long without a crash of its numbers! Also, *T. scripta* in the Flint River, Georgia are suffering from the same necrotic shell disease as the *Pseudemys concinna* there. Populations of the Rio Grande slider, *Trachemys gaigeae*, in the United States are scattered and, some at least, seem small, but few data are available regarding this species.

Little is known of the status of the chicken turtle, *Deirochelys reticularia*, but it may be experiencing a decline in southern Florida because of habitat alteration and increased motorized traffic.

A strictly northern species, Blanding's turtle, *Emydoidea blandingii*, has most of its range occurring in the Upper Midwest. Seasonally, it spends much time migrating overland from its primary aquatic habitat to vernal feeding pools or nesting grounds, and, as such, is particularly vulnerable to loss of wetland habitat. Its numbers are declining nationally, and it must be considered a candidate species for federal listing.

The two box turtles in the United States, the woodland-dwelling eastern box turtle, *Terrapene carolina*, and the grassland-inhabiting ornate box turtle, *Terrapene ornata*, have become much desired in the foreign pet trade, and hundreds of thousands have been exported in recent years. Almost all of these are adults taken from wild populations. Obviously, these two species cannot withstand this cropping. Their numbers had previously declined because of our own activities, such as the continuous rape of their habitats and the modern increase in automobile traffic. In 1994, these species were added to the IUCN/SSC Cites Appendix II, and their export is now monitored by the USFWS. In the northcentral region, the two box turtles are primarily found in the southernmost states and are probably limited by climatic factors.

The wood turtle, *Clemmys insculpta*, along with its relatives the spotted turtle, *Clemmys guttata*, and the bog turtle, *Clemmys muhlenbergii*, face special problems. The bog turtle by its habitat selection has threatened its own continued existence. It inhabits shallow, boggy, seepage areas, usually in pastures or along the flood plains of streams in woodlands, which are the last stages of succession as a waterbody dries and changes to land. It further compounds this problem with a life strategy of small population size (usually less than 50 individuals, pers. obs.) coupled with low reproductive output (1–6 eggs/clutch, usually 2–3; one clutch/year; Ernst et al., 1994). Living in such a chancy habitat may be all right if there are other such habitats nearby to which the bog turtles can migrate if their home bog dries up. However, over the last 30 years many such areas have been drained or filled for commercial or housing development or to produce more agricultural land, thus depriving the turtles of both primary and secondary habitats. The commercial trade in bog turtles has also eliminated entire populations (pers. obs.). Commercial trade in *Clemmys muhlenbergii* is now illegal as *C. muhlenbergii* is protected as endangered in most of the states where it occurs and is under consideration for such listing in the others and a candidate species for federal listing. The bog turtle was added to the Appendix I of the Convention on International Trade in Endangered Species (CITES) in 1992. The wood turtle, *C. insculpta*, is also protected in most states and was included in Appendix II of IUCN/SSC CITES in 1992. It has recently declined in many parts of its range, particularly because of commercial collection for the pet trade. An attempt to have the wood turtle federally listed as threatened failed in 1994 for dubious reasons. It is hoped that it will be protected federally in the near future. *Clemmys guttata*, the spotted turtle, is currently exploited for the pet trade, and it also is experiencing the disappearance and degradation of its aquatic habitat. The fourth species of the genus, the western pond turtle, *Clemmys marmorata*, lives in the Pacific states. It too is in severe trouble due to pet trade collection, habitat degrada-

tion, especially in the southern part of its range, and recently introduced disease. It is now a candidate species for federal protection, and California is also considering protecting it.

To complete the survey of the North American turtle fauna the true terrestrial tortoises of the family Testudinidae must be mentioned. All three of our species are protected by the states in which they reside, and all three have suffered population declines primarily from habitat destruction, pet trade collecting, and various human disturbances, but other factors such as natural predation, and mycoplasmosis (upper respiratory tract infection) from reintroduced pets have taken their toll (Jacobson et al., 1995). These three species are the desert tortoise, *Gopherus agassizii*, of the southwestern United States and northern Mexico (some populations federally listed as threatened, others candidates for listing), the Texas tortoise, *G. berlandieri*, of southwestern Texas and adjacent Mexico, and the southeastern gopher tortoise, *G. polyphemus*, whose populations west of the Mobile and Tombigbee rivers in Alabama, Louisiana and Mississippi are listed as threatened by the USFWS.

Each declining turtle species in the United States is faced with a different suite of detrimental pressures, and must be examined individually. A thorough knowledge of the life history of each species is required to address these specific problems. The overall effects of two pressures are greatest: habitat destruction in its many forms (including pollution) and commercial exploitation. The human factors for these are overpopulation and, often, greed. We must either regulate habitat alteration or reach a balance between the needs of wildlife and those of humans, and we must severely curtail mass collection of turtles for sale in the pet trade, especially for foreign export. If we can achieve these soon, and continue to clean up our environment, the freshwater and terrestrial turtle fauna of the United States will continue to be diverse and species rich. If we do not, the existence of every species of turtle in North America will be at least threatened in the 21st century.

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Mercury Levels in Snapping Turtles, *Chelydra serpentina*, from Wisconsin

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Abstract

Mercury concentrations in muscle tissue of seven Wisconsin snapping turtles, *Chelydra serpentina*, averaged 0.21 mg/kg (range = 0.16–0.27 mg/kg). These levels are relatively low in comparison to levels found in sport fish from the same waters and suggest limitations in the use of snapping turtles as biological indicators of mercury contamination. Limited sample size and the lack of a statistically designed sampling regime preclude broad interpretation of these data. Further investigation is recommended.

Snapping turtles, *Chelydra serpentina*, have been suggested as useful indicators of cumulative pollutants in aquatic ecosystems. They have a wide distribution (Conant and Collins, 1991) and are relatively long-lived (Galbraith and Brooks, 1987; 1989). Additionally, snapping turtles are believed to be relatively sedentary (Galbraith et al., 1987; Obbard and Brooks, 1981), are found in both polluted and "clean" habitats, and are easily collected.

Hall (1980) reviewed the effects of environmental contaminants on reptiles. He found that comparatively few studies had been completed on turtles. Much research has been completed since that review, and recent studies have linked environmental contaminants (i.e., organochlorines) with developmental anomalies in snapping turtles (e.g., Bishop et al., 1989; Bishop et al., 1991; Environment Canada, 1991).

Few studies have investigated the accumulation of metals or the associated effects of such accumulation in snapping turtles (Hall, 1980; Watermolen, unpubl. rept.). Mercury is a ubiquitous contaminant in aquatic ecosystems. Organic mercury—particularly methyl mercury—bioaccumulates, has a relatively long retention time in the body, and can affect the nervous system and developing organs. Because of the relative paucity of metals data for turtles, we report here concentrations of mercury in seven snapping turtles collected in Wisconsin in the 1980s. We compare these concentrations with mercury levels found in sport fish from the same waters.

Methods

Seven small to medium-sized snapping turtles were collected from four Wisconsin counties (Figure 1) incidental to Wisconsin Department of Natural Resources fisheries management

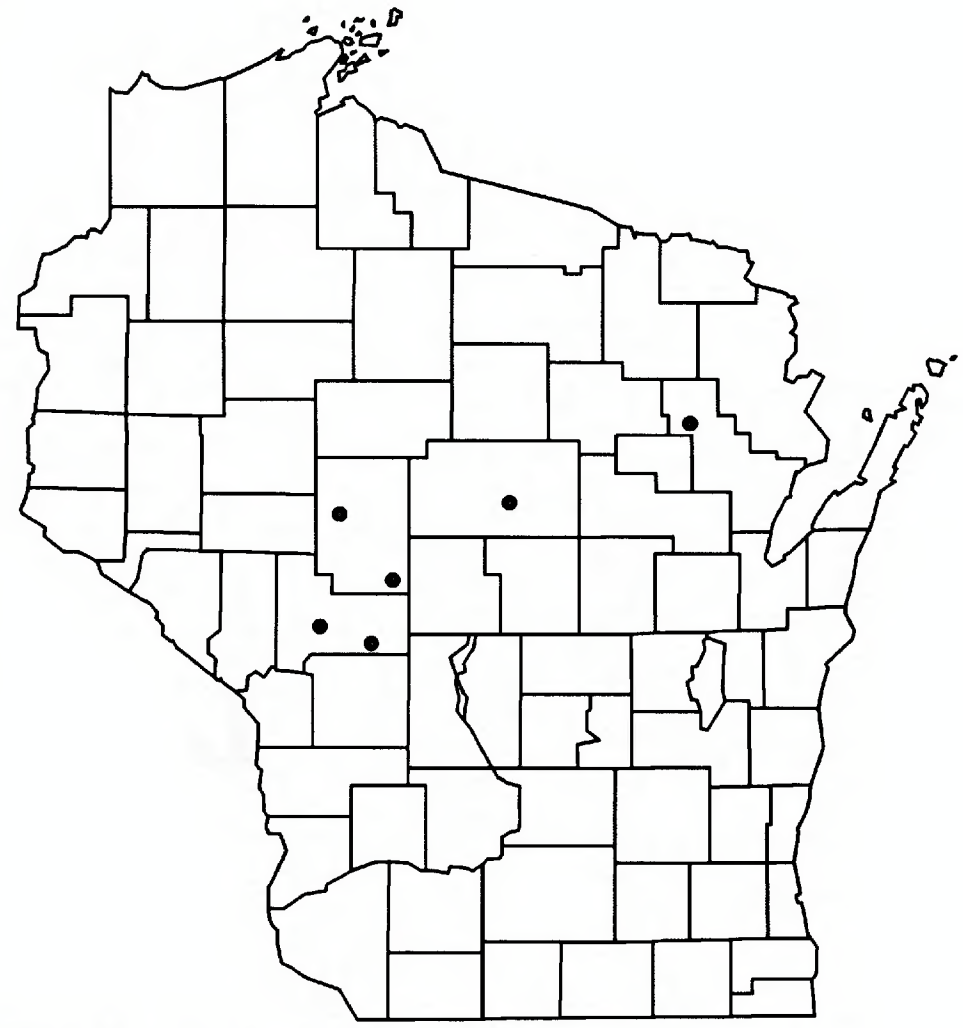

Figure 1. Locations of turtle collection sites.

Table 1. Summary information for collection locations (from Anon., 1991; Carlson and Anderson, 1977; Carlson et al., 1977; Klick and Threinen, 1965; 1968). Lake types: D = drainage; I = Impoundment; S = Seepage.

Lake (County; Location)	Lake type	Area (acres)	Depth (feet)
Mead Lake (Clark; T27N, RCW, S29)	D	320	16
Sherwood Lake (Clark; T23N, R1E, S34)	D	117	9
Harkner Flowage (Jackson; T20N, R2W, S23)	I	38	14
Black River Falls Pond (Jackson; T21N, R4W, S14)	I	198	34
Lake Wausau (Marathon; T28N, R7E, S24)	I	1918	30
McComb Lake (Oconto; T31N, R16E, S28	S	20	34

ctivities between 1984 and 1987. No statistically designed sampling regime was established for the collection of turtles.

Summary information for the sampled sites is provided in Table 1. The sampled lakes occur in areas of Wisconsin that are susceptible to acid deposition and thus have a potential for mercury accumulation (Wisconsin Acid Deposition Research Council, 1994).

Red meat from large muscles (e.g., *pectoralis majoris*) was dissected from the turtles, homogenized in a blender, digested in nitric acid, and analyzed with atomic absorption spectrometry. Analyses were conducted by the Wisconsin State Laboratory of Hygiene following the protocol outlined in the lab's methods manual (Wisconsin State Laboratory of Hygiene, 1991). Concentrations were recorded on a wet weight basis.

Results and Discussion

Mercury generally has an affinity for sulfhydral groups which make up proteins, and as a result concentrates in muscle tissue (Jernelov et al., 1975). Mercury concentration levels found in the sampled turtles are summarized in Table 2; the mean concentration was 0.21 mg/kg (range = 0.16–0.27 mg/kg, n = 7).

Although no other snapping turtles have been sampled for mercury in Wisconsin, the concentrations we found are comparable to levels found in snapping turtles in other states. Helwig and Hora (1983) found a mean mercury concentration of 0.145 mg/kg in the meat of Minnesota snapping turtles (n = 17, range = 0.05–0.3 mg/kg). Mercury levels ranged from 0.46 to 1.28 mg/kg in the livers of 32 snapping turtles collected in Maryland and New Jersey, and from 0.39 to 0.56 mg/kg in kidneys from the same animals (Albers et al., 1986). These levels may appear significantly higher than the levels we found. However, the liver and kidneys generally contain substantially higher levels of many heavy metals than does muscle tissue from the same animal (e.g., Rothstein and

Table 2. Mercury concentrations in Wisconsin snapping turtles.

Collection Date	Turtle Weight (kg)	Collection Location	Concentration (mg/kg)
06/26/84	2.61	Lake Wausau	0.18
07/12/85	9.54	McComb Lake	0.26
07/08/86	2.84	Sherwood Lake	0.17
07/22/86	6.59	Harkner Flowage	0.16
07/22/86	6.36	Harkner Flowage	0.22
07/23/86	3.30	Black River Falls Pond	0.27
04/21/87	3.85	Mead Lake	0.20
Mean	5.01		0.21

Hayes, 1964; Sheffy and St. Amant, 1982; Niethammer et al., 1985; Davenport and Wrench, 1990). Concentrations in liver tissue generally reflect the initial site of contaminant disposition and reflect recent exposure, whereas concentrations in muscle tissue are the result of contaminant redistribution and generally reflect chronic exposure (Nordberg, 1976).

Snapping turtles are omnivorous, with diets consisting of approximately one-third fish, one-third plant material, and one-third miscellaneous material including mollusks, crustaceans, insects, amphibians, birds, scavengings, sediments, and refuse (Alexander, 1943; Lagler, 1943; Coulter, 1957). Many of these food items are known to accumulate mercury (Environment Canada, 1991). However, there is considerable variation as to the importance of different food items, with a high correlation between the availability of food items and the amount of each taken (Alexander, 1943). Snapping turtles feeding in contaminated areas could be exposed to persistent

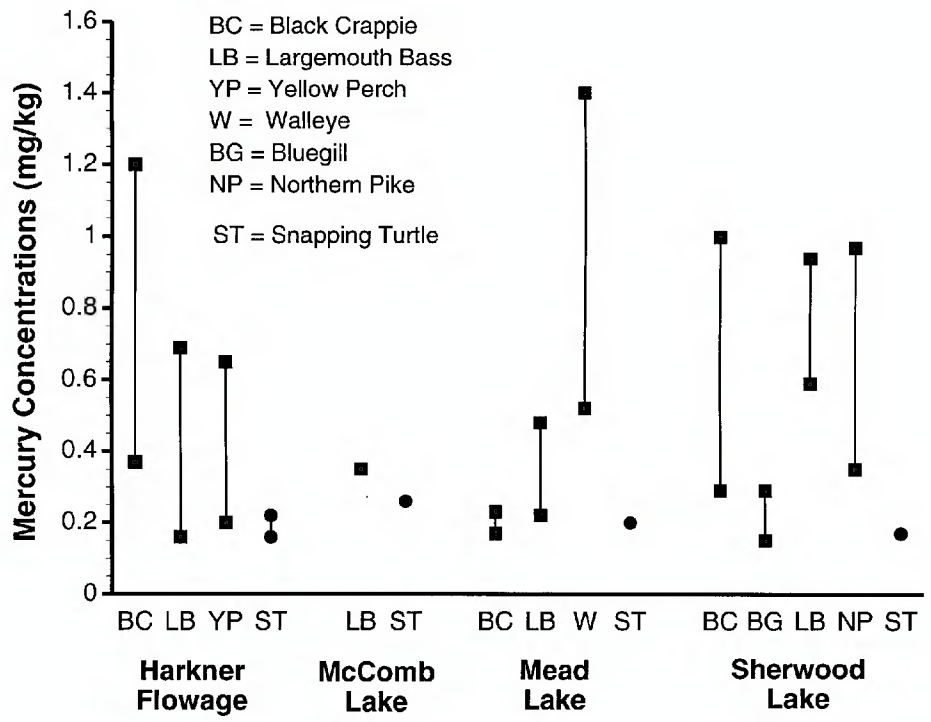

Figure 2. Mercury concentrations in snapping turtles (●) and sport fish (■) from four lakes with fish consumption advisories (source: Wisconsin Department of Natural Resources Contaminant Monitoring Program, unpubl. data).

contaminants through dietary intake. Without dietary information for the sampled turtles we cannot conclusively state that the observed accumulation is a result of feeding behavior. However, if this is the case, snapping turtles could be expected to have contaminant body burdens comparable to other cold-blooded species occupying similar trophic positions (assuming similar pharmacokinetics).

While neither the U.S. Food and Drug Administration (FDA) nor the Wisconsin Division of Health (DOH) have recognized specific tolerance or action levels for deleterious substances in snapping turtles, levels found in the sampled turtles were below the 1.0 mg/kg FDA action level for mercury in sport fish and the DOH 0.5 mg/kg fish advisory level. Four of the six sampled sites appear on Wisconsin's fish consumption advisory (Wisconsin Department of Natural Resources and Divison of Health, 1994), meaning that certain species and sizes of fishes found at the sites exceeded the DOH advisory level. Comparison with these sport fish data suggests that snapping turtles have lower mercury levels than do sport fish, even in areas with a high potential for mercury accumulation (Figure 2).

Mercury accumulates progressively with age, and thus size, in fish (Kleinert and Degurse, 1971). We suspect that the same holds true for snapping turtles. Our data do not allow us to confirm or refute this possibility. However, the largest turtle sampled had one of the highest mercury levels observed and the smallest turtles had some of the lowest mercury concentrations. Analysis of contaminant burdens in multiple turtles from the same body of water, but of different ages could shed further light on this relationship.

Apparently, mercury does not accumulate in snapping turtles to the same levels found in sport fish from the same areas. Possible explanations include: 1) snapping turtles do not accumulate as much mercury through dietary intake, 2) their diet is varied enough so that high levels are avoided, or 3) the turtles have a means of metabolically removing mercury after consumption. Mercury concentrations in other top-level predators such as river otter (*Lutra canadensis*) and common loons (*Gavia immer*) are better correlated to mercury concentrations found in areas where they reside (Kucera, 1983; Wren et al., 1986; Endsor et al., 1992; pers. obs.). It could be argued that because a greater proportion of their diet is fish (58-100%; Lagler and Ostenson, 1942; Olson and Marshall, 1952; Peterson, 1965; Knudsen and Hale, 1968; Dulin, 1988), these species accumulate higher levels of mercury.

Mercury levels in the sampled turtles appear to be low. However, given the small sample size and the lack of a statistically designed sampling regime, it is not possible to draw definitive conclusions about mercury levels in snapping turtles on a statewide basis. It is also difficult to interpret the significance of these findings because little is known about baseline levels and physiological effects of heavy metals in these animals. Other contaminants (e.g., organochlorines) may accumulate to greater levels and may be of more concern from both an ecological and human health standpoint. We recommend that a statistically valid sampling effort be undertaken to assess contaminant burdens in Wisconsin snapping turtles and their associated effects. Such work should be accompanied by laboratory studies to better understand any physiological basis responsible for differential accumulation.

Acknowledgements

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Bull. Chicago Herp. Soc. 30(11):234-236, 1995

NEWTLINE

President **Marcia Rybak** greeted visitors and members as they gathered into the A. Montgomery Ward Lecture Hall in the Field Museum for the monthly meeting of the Chicago Herpetological Society on September 27, 1995. She thanked everyone for all their help with the Chicago Academy of Science's HerPETological Weekend on September 23 and 24, and reported that it was a tremendous success. With one event down and one to go, Marcia introduced Chairperson **Char Haguewood**, who announced that the excitement level was high and everything was set for the upcoming Midwest Herpetological Symposium on October 20-22. She did, however, still need volunteers to pick up some of the speakers from the airport. **Dave Golde** asked members who were interested in attending a monthly Amphibian Club meeting to please see him for more information. Sales Merchandiser **Joan Moore** was on hand to present specials on books from overseas.

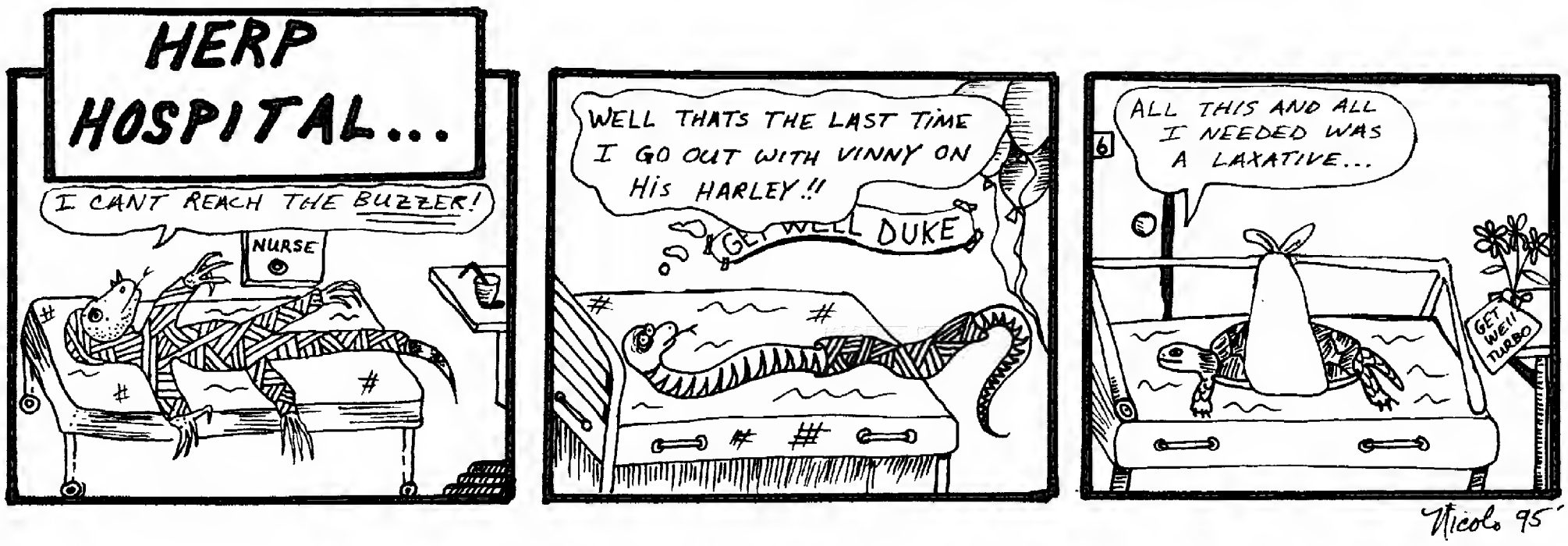
The business portion of the meeting was followed by a short intermission and raffle. **Stephen Barten, D.V.M.** introduced the evening's guest speaker: veterinarian, author, and photographer **Dr. Douglas Mader**. Dr. Mader's introduction to the CHS came by way of his association with his colleague Dr. Barten. Ironically enough, Dr. Mader introduced Marcia Rybak to Dr. Barten and the rest is presidential history. Dr. Mader grew up in Hawaii and attended the University of California where he studied primate medicine. It wasn't long before he opened his own practice, the Long Beach Animal Hospital in Long Beach, California. "My practice is very busy, what with the L.A. riots, floods and earthquakes", explained Dr. Mader. He remarked that his animal hospital became a part of national history when a "white Ford Bronco was shown speeding past" the animal hospital on live television. For those who have not had the pleasure of visiting California, Dr. Mader explained the liberal attitude among its citizens and eccentric Hollywood stars, "If you own a fishing license, you can own a rattlesnake!" Dr. Mader's clients range from the usual assortment of dogs, cats, rabbits, birds and fish—to potbelly pigs, lots of primates, mink, bats, as well as a wide variety of reptiles and amphibians. His practice also entertains "L.O.L.s" (Little Old Ladies who sit in the lobby all day just to watch the wide array of animals parade by—cheaper than a movie and not as much walking as the zoo).

Dr. Mader estimates that there are 50 million cat owners, 45 million dog owners and, surprisingly enough, that there are 7 million reptile owners in the United States alone. He began his slide presentation, "Advances in Herpetological Medicine," by showing photos of actual cases to illustrate the advancement in herpetological medicine in recent years. Similar to a pre-med class, we witnessed various scenarios involving different patients, and were asked to identify the animal, diagnose it and recommend treatment. This gave us the giddy pleasure of pretending to be a veterinary assistant for the evening.

Our first test case began as Dr. Mader asked us to identify the animal in the photo. It was a desert tortoise. He explained why the animal had been brought in and what its symptoms were (i.e., not eating well and no bowel movements in months). He then asked what we would do first. He suggested we give the animal a physical and follow up with an X-ray. The X-ray revealed a bladder stone. In addition, the tortoise was egg bound. After much prompting, we recommended that the bladder stone be surgically removed and the animal be spayed (to avoid a recurrence).

The next case involved "Skinky", you guessed it, a 4-year-old blue-tongue skink. Dr. Mader was quick to compliment owners on such original names ("Iggy," "Monty" etc.). "Skinky" was also not eating and had not passed any stools. After a pretend physical examination, we looked at the X-ray of Skinky's stomach. It revealed a large solid object. It was then learned that the owner thought Skinky was lonely and put a rubber "sticky" toy in his cage to keep him company. Dr. Mader joked, "Every year I send this client new rubber toy as a gift". Bon appétit.

Also in Dr. Mader's "stupid category" (stupid reasons the animal is sick) was a large python whose "brain-dead" owner



had stabbed it with a knife after he fed it a piece of chicken and the snake mistook the owner's arm for the chicken. This snake required a blood donation and Dr. Mader's primary blood donor, his resident python "Bux," came to the rescue. He noted that he never transfuses an animal twice without cross matching.

Next in the "stupid category" was a Honduran milksnake whose skin was bubbling and eyes were opaque. We learned it had gotten out of its cage and into the washing machine. The diagnosis was a severe case of pneumonia, near drowning and static cling.

Dr. Mader reminded us that it isn't always the owner that is the stupid one. An iguana with third-degree burns from a heat-lamp was shown. (Third-degree is when the damage goes all the way to the muscle tissue.) The iguana was anesthetized and the dead tissue was cut away. Antibiotics were administered and a sterile bandage was used (i.e., a bandage covered with moist saline and then covered with a dry bandage.) Dr. Mader reminded us that this type of injury can be very expensive to treat and requires a long time to heal. He recommended that heat lamps be kept outside the cage.

This was followed with a photo of a Florida kingsnake with its owner. In the photo, it was clear that the owner had a bad case of ring worm all over her body. We learned that she had gotten this from her cat and, to her surprise, had passed it on to the snake. He ended up treating the snake and cat, and sending her to an M.D. Dr. Mader reminded us to always wash our hands before and after handling an animal.

Next was a photo of 12-foot-long boa constrictor with a large mass in its mid-section. Dr. Mader noted that he X-ray revealed it was an ovarian tumor. After surgical removal, the animal recovered nicely.

An albino Burmese python was shown with deep lacerations. The owner had tried to save money and treat the wounds himself. The owner had applied a disinfectant which was meant for fish that he had purchased at a pet store and sewed up the holes with ordinary needle and thread. An absolutely grotesque photo of the snake was shown, illustrating the effects of such improper treatment. Infection had set in and the entire upper body and lower jaw of the snake had exploded. The dead tissue was cut out and skin grafts were applied. After the bacteria was cultured, it was revealed that it was a strange staph infection. Dr. Mader put the animal on 24-hour intravenous fluids and antibiotics. A photo of the same snake months later was shown. It had healed leaving behind only a small scar. Dr. Mader reminded us that when live rats are placed in the cage with a snake, it is often the case that the snake becomes the food for the rat. He recommends feeding a snake a dead diet and, if live food is necessary, be sure to leave enough food and water for the rat in the same tank.

Next was a boa constrictor with a bad case of mouth rot and pneumonia. We learned that its owner had dropped the cage on its neck. The owner had applied a head and neck splint and bandaged up the area. An X-ray indicated that several vertebrae were out of alignment. Dr. Mader brought in a chiropractor who applied a treatment similar to that of humans and realigned the snake. It also recovered nicely.

The next animal was an albino Burmese python shown to have dark wounds and bruises. The owner admitted he had run over it with his motorcycle. Dr. Mader called this "The Uncool Factor", (owners who ride around motorcycles with their reptiles on their shoulders). He charges extra for this "stupidity factor" and then persuades the owner into giving the animal away.

The next case was the saga of another desert tortoise, 40-year-old "Turbo Jet". He hadn't eaten in four months, was obese, constipated and suffered a wound on its left leg. The owner had been tube feeding the geriatric tortoise who was obviously in very poor health. It was alarming to learn that in California, it is a common practice for a tortoise owner to drill a hole in shell of a tortoise and tie it up in the backyard. The tortoise's previous medical history revealed that it had been treated with the antibiotic "Gentamicin" 1 year prior for an upper respiratory infection. After lab tests and an X-ray were taken, it was discovered that the bones in the left foot were dissolving and uric acid levels were high. Dr. Mader treated the tortoise with anti-inflammatory medicine and steroids and sent home. Home care consisted of a daily soaking in warm water, periodically soaking the left foot in diluted iodine, tube feeding of "Veggie Gruel", administering a thyroid supplement and a medication to lower uric acid levels. After time, the wound healed and Metamucil was added to the diet. However, the tortoise still could not walk or pass a stool. Upon further examination through endoscopy, a bladder stone was found, along with white spots and crystals on the liver (visceral gout). A catheter was inserted and the tortoise was put on painkillers and a drug to help with urination. Four days later, Eureka! Feces and urine. He began eating again and pulling himself with his front legs. Sadly, this story does not end here. Four months later, its owner went on vacation and a housesitter neglected to give the tortoise its medication. He relapsed and the housesitter took him to an emergency clinic where a laxative, "DSS", was administered. The tortoise died instantly. DSS is toxic to turtles.

The saga of "Sophie", a Chinese water dragon, with a broken rear leg was next. The owner of this animal was more than determined to save it, no matter what the cost. An X-ray revealed a non-union fracture. The broken bone was not healing properly and parts of the bone were dissolving. The leg required surgery. The bone was rebroken and the tips were sharpened to help in the regrowth. A pin was inserted to keep the joint fixed. The owner was told to keep the lizard immobile. The lizard, however, was not willing to cooperate. Upon re-examination, the bone had to be realigned and sharpened. This time, pieces of bone were graphed from the lizard's hip and mashed up around the fracture to reinforce it. A sterile dental acrylic was applied to perpendicular bars to keep the leg immobile. All looked good until the next check-up. The incision had become infected. After culturing the bacteria and administering the appropriate antibiotic, Dr. Mader decided to try as a last resort a revolutionary treatment that another vet had invented involving an electronic bone simulator built

from a hearing aid battery. One was custom-built for this lizard and attached to its leg. Six weeks later, an X-ray revealed the bone had completely healed. This success story resulted in the hatching of several baby water dragons and subsequently, she has laid 13 clutches!

The final photo was that of another "Skinky". This lizard was thought to have cancer. It was anesthetized and a bone scan was conducted using radioisotopes injected into the tail vein to create a "gamma" picture. An MRI revealed a kidney abscess; however the owner wanted no part of expensive surgery. Instead, anti-fungal medication was administered and several months later, the lizard was fine.

Dr. Mader explained that a few years back he was run over by a drunk driver and made a lot of friends in the E.R. When a unique case appears, requiring expensive equipment such as that needed for MRI, he sometimes takes the animal to his friends at the human hospital. He takes them in the evening and makes sure that everything is sanitary before and after he leaves.

Dr. Mader wanted us to know that he first offers his clients the best and highest treatment possible. He leaves it up to them as to the amount they are willing to spend on such treatment. Dr. Mader reminded us that every animal is different and that treatment such as that administered in the above test cases may not always be consistent with what is required. For example, he noted that Tylenol ingested by cats is lethal. His primary goal is not to cause the animal more pain than when they were admitted and, his credo is "Above all, do no harm".

Look for Dr. Mader's new book, *Reptile Medicine & Surgery* (around $89) to come out in November, as well as his regular contributions to magazines like *Reptiles* and *Vivarium*.

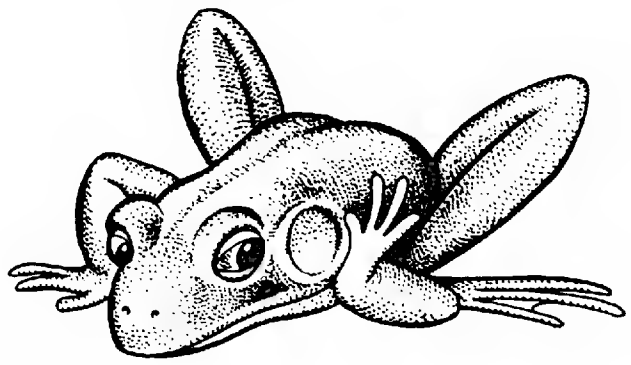
We stay in touch, so you stay in touch.

NEWT

Bull. Chicago Herp. Soc. 30(11):236, 1995

The Tympanum

Please accept my deep gratitude . . . for helping to make this year's HerPETological weekend such a success.



Let me just say that I am so pleased we were able to continue the event and the tradition in our new downtown facility. I appreciate the patience of Herp Society members as they adapted to our new space. I know our staff tried to make the transition as easy as possible. We value your participation and contribution as an affiliated society.

I trust that the event itself was as beneficial to the Society as it was to the Academy. We welcomed 2400 visitors and received coverage on all of the Chicago-based TV stations, with additional publicity in the *Chicago Tribune* and *Sun-Times*, among others. Please extend my thanks to all Society members who participated. We look forward to next year!
Paul G. Heltne, Ph.D., President, Chicago Academy of Sciences, 2060 N. Clark Street, Chicago IL 60614.

Thanks!

The Midwest Herpetological Symposium was a great Success! I would like to thank all the committee members and other volunteers who helped make my job easier. I couldn't have done it without you.

Thanks too, to those of you who had tables at the Captive Bred Sale and the Dry Goods Sale.

A special thanks to our speakers who helped make this year's symposium an enlightening and memorable one.

See you next year in St. Louis.

Char Haguewood, Symposium Committee Chairperson

CHS Adoption Service

The CHS adoption service has an abundance of herps that need new homes. Common animals found on the service are green iguanas, caimans, red ears and box turtles, and common species of pythons and boas. Less common animals are placed on the service from time to time. Frequently the service receives calls from distressed owners or "finders" of animals that cannot care for the animals correctly. If you're interested in adopting one of these animals as a pet, and can care for it properly, please contact Char Haguewood at 708/209-1426, weekdays 7-9pm CST.

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Bull. Chicago Herp. Soc. 30(11):237-239, 1995

Herpetology 1995

In this column the editorial staff presents short abstracts of herpetological articles we have found of interest. This is not an attempt to summarize all of the research papers being published; it is an attempt to increase the reader's awareness of what herpetologists have been doing and publishing. The editors assume full responsibility for any errors or misleading statements. JCM

THE EARLIEST KNOWN JUMPING FROG

N. H. Shubin and F. A. Jenkins, Jr. [1995, Nature 377:49-52] report the discovery of a fossil frog with primitive characteristics. Characters shared with modern frogs are fused caudal vertebrae, a rod-shaped ilium, and elongated hind limbs. The new species, *Prosalirus bitis*, is placed in a new family, Prosaliridae. The species name comes from the Latin *prosalire* meaning to leap forward, and the Navajo term, *bitis*, meaning high over it. The remains were found in the silty facies of the Kayenta Formation, in Gold Spring Quarry, Adeii Eechii Cliffs, Coconino County, Arizona; and are dated as being Early Jurassic (Pliensbachian). An earlier known frog, *Triadobatrachus massinoti*, (Early Triassic, Madagascar) lacks the extremely shorted trunk and hind limb elongation seen in modern frogs and does not have the mobility in the pelvic and hindlimb joints seen in modern frogs and *Prosalirus*; thus *Triadobatrachus* could not jump. The authors note that the earliest known fossils of salamanders, caecilians and jumping anurans are now known from Laurasian landmasses, and that this is in direct opposition to previous hypotheses that suggested Gondwanaland as a center of origin and dispersal for amphibians; and they suggest that the Early Triassic *Triadobatrachus* of Gondwanaland and the Early Jurassic Laurasian *Prosalirus* support a cosmopolitan distribution of early frogs. This view is also supported by the distribution of living primitive frogs, *Ascaphus* in North America and *Leiopelma* in New Zealand.

FORAGING MODES COMPARED IN SNAKES

S. M. Secor [1995, Herpetological Monographs 9:169-186] demonstrates the correlation of an array of ecological characteristics with foraging mode in the sit-and-wait sidewinder, *Crotalus cerastes*, and the active-foraging coachwhip, *Masticophis flagellum*. Sidewinders are mostly nocturnal and spend much of their time on the surface coiled on or partially buried in the sand waiting to ambush prey. Coachwhips are strictly diurnal, cruising through the habitat searching for active and sedentary prey. In this study sidewinders averaged 7.2 h/d on the surface, almost twice the time of coachwhips, which spent 3.9 h/d hunting. Surgically implanted radio transmitters showed that active coachwhips' body temperatures stayed within a narrower range and were significantly higher (30–35°C) than those of active sidewinders (16–38°C). Coachwhips moved an average distance five times greater than did sidewinders (186 m/d as compared to 35 m/d). The coachwhips' activity range averaged 53.4 ha, while the sidewinders' activity range was 20.1 ha. The body shape of these snakes is also correlated with foraging modes: sidewinders are short and stout and rely on crypsis and immobility to escape predation, while coachwhips are slender and depend on speed to capture prey and escape predation.

BUSHMASTER FEEDING BEHAVIOR

D. M. Boyer et al. [1995, Herpetological Monographs 9:161-168] report bushmasters (*Lachesis muta*) at the Dallas Zoo demonstrated strike-induced chemosensory searching (SICS) and trail-following when feeding on relatively large prey (> 25% of snake body mass). Smaller prey were usually held following predatory strikes. Facultative use of the strike-and-release pattern based on prey size has not previously been documented for any rodent-feeding viper. One experiment documented the relationship between prey mass and poststrike holding or releasing. A second experiment showed that SICS occurred after large prey were released. A third experiment revealed that bushmasters followed chemical trails after releasing large prey, indicating that trailing behavior is a facultative component of predation in the bushmaster.

NORTHERNMOST COTTONMOUTH POPULATION

C. R. Blem and L. B. Blem [1995, J. Herpetology 29(3):391-398] report the northernmost population of the eastern cottonmouth, *Agkistrodon p. piscivorus*, is near Hopewell, Virginia, at the confluence of the James and Appomattox Rivers. Female cottonmouths there produce relatively large litters and attain sexual maturity at sizes greater than reported elsewhere. Meristic characters of this population differ only slightly or not at all from neighboring populations in southeastern Virginia and northeastern North Carolina, but melanism increases significantly southward. Vitellogenesis, ovulation, and birth appear to occur several weeks later than in southern populations. Most small cottonmouths did not survive cold winters and few individuals less than 600 mm in body length were observed. Thus the population is comprised of snakes four years old or older. Most females (91.7%) reproduce annually. Winter mortality in hibernacula may be an important limiting factor for this population.

A NEW TURTLE FROM SULAWESI

W. P. McCord et al. [1995, Chelonian Conservation Biology 1(4):311-316] describe a new species of batugurid turtle, *Geoemyda yuwonoi*, from northern Sulawesi, Indonesia. It differs from other batagurids by its relatively large size (256 mm carapace length in males); relatively low, tricarinate, orange-brown carapace; unhinged and unstreaked plastron; very short intergular and very long interanal seams; well-developed bony bridge; distinctive dark brown and white, sexually dichromatic head coloration; laterally cusped upper tomium; hooked beak supported by anterior contact of the maxillary; and lack of a postorbital bar. This is only the second batagurid turtle known to occur east of Wallace's Line. Precise locality data is unavailable since the seven specimens were purchased from local people by Frank Yuwono, an Indonesian tropical fish exporter, for whom the turtle is named.

LARVAL MARBLED SALAMANDERS EAT THEIR SIBLINGS

S. C. Walls and A. R. Blaustein [1995, Animal Behavior 50:537-545] examine the effect of kinship on larval cannibalism in the marbled salamander, *Ambystoma opacum*. In separate behavioral trials cannibalistic larvae were presented with two smaller conspecifics (a "prey group"), matched for size, that were (1) siblings of the cannibal, (2) nonsiblings and (3) one sibling and one nonsibling (mixed sibship). Larvae were allowed to consume only one conspecific during each trial. This experiment was repeated in two consecutive years with larvae from two different populations. In both years, significantly fewer cannibals ate nonsiblings from the mixed sibship group than from groups composed of two nonsiblings. In contrast, the number of cannibals that ate a larva from the pure sibling prey group did not significantly differ from the number that ate their siblings from the mixed sibship prey group. Thus, small larvae were significantly more vulnerable to cannibalism by their siblings than by nonsiblings. The availability of unrelated individuals as alternative prey did not deter cannibals from eating their siblings, even though cannibals readily consumed prey of either genotype when the alternative one was absent. The kinship-biased cannibalism apparently was not due to size-selective predation or to differences among sibships in their propensity to cannibalize siblings. Moreover, the behavior of potential prey did not differ towards related versus unrelated cannibals during initial observations of larval interaction. Cannibals required similar amounts of time to capture and process both sibling and nonsibling prey. To the authors' knowledge, the results provide the first evidence of sibling cannibalism when unrelated individuals are available as alternative prey.

TAIL BREAKAGE IN A SNAKE

J. B. Slowinski and J. M. Savage [1995, Herpetologica 51(3): 338-341] report that Neotropical colubrid snakes in the genus *Scaphiodontophis* possess very long, fragile, but thickened tails which may be 50% of the total length. Adults in museum collections often show incomplete tails, damaged by multiple encounters with predators. This is the first time this defense mechanism has been found in a tetrapod that lacks the ability to regenerate its tail.

ANURAN ACTIVITY IN AMAZONIAN PERU

W. E. Duellman [1995, J. Herpetology 29(1):13-21] sampled frogs over a six-year period at a site in seasonal lowland tropical rainforest in southern Amazonian Peru. Three sampling periods were at the beginning of the rainy season in 1986, 1989 and 1991; two were in the middle of the rainy seasons of 1986 and 1990, and one was in the dry season of 1989. Sampling was done along a system of trails and in four series of quadrats. A total of 5236 individuals of 61 species of frogs was recorded during the study. Analysis of the data on the 20 most abundant species reveals that anuran activity is closely correlated with the occurrence of peaks of heavy rainfall rather than total rainfall during the sampling period. There is no compelling evidence for declining frog populations at this site.

A LIZARD RECOGNIZES SNAKE ODOR FROM BIRTH

R. Van Damme et al. [1995, J. Herpetology 29(1):38-49] report that the ability to recognize chemical cues from predatory snakes is congenital in the common lizard *Lacerta vivipara*. This conclusion follows from a series of experiments in which the authors observed the behavior of naive lab-born lizards in terraria that had previously been inhabited by predatory snakes. Chemicals from both the viper, *Vipera berus* (a sympatric predator), and the smooth snake, *Coronella austriaca* (an allopatric saurophagic snake), elicited a sharp increase in tongue-flick rates. The lizards, when confronted with snake chemicals, exhibited an increased number of foot shakes, tail vibrations, and starts resembling those of adults. The only quantitative age-related difference concerned thermoregulatory behavior; whereas juveniles refrained almost completely from basking in the presence of snake chemicals, adult lizards basked equally long in snake and controlled experiments.

DIAMONDBACK TERRAPIN RESOURCE PARTITIONING

A. D. Tucker et al. [1995, Herpetologica, 51(2):167-181] investigated the foraging ecology of the diamondback terrapin, *Malaclemys terrapin*, in South Carolina, by examining fecal samples for evidence of resource partitioning. Seventy-six to 79% of the dietary volume was the saltmarsh periwinkle, while crabs, barnacles, and clams made up the rest of the diet. Females of this turtle have larger heads and bodies than do the males, and therefore females eat larger food items, and a greater variety of food than males. Dietary overlap is greatest when the females are young and about the same size as the males. High tides allow the turtles to forage in the upper ends of the saltmarsh and prey size and distribution are variable and change with the tides. Divergent foraging strategies for terrapins with different head widths may result in habitat partitioning. Food accessibility rather than food abundance may be a limiting factor for terrapins in areas of high tidal variability.

PIGMY RATTLESNAKE REPRODUCTION

T. M. Farrell et al. [1995, J. Herpetology 29(1):21-27] studied reproduction in female pigmy rattlesnakes, *Sistrurus miliarius barbouri*, in central Florida. Twenty-six females were captured and held until parturition or were found in the field with their litters. Over 92% of the snakes gave birth in August. Individuals with large clutch masses gave birth earlier in the season than individuals with small clutch masses. Mean clutch size was 5.88 (range 2–11). Litter size and clutch mass were significantly correlated with female snout–vent length. There was significant variation in offspring size among females, but this variation was not a result of larger females having larger young, or the young being smaller in larger litters. Of 19 females whose reproductive condition was determined in the summers of both 1992 and 1993, 32% were not gravid in either year, 42% were gravid in one of the two years, and 26% were gravid in both years. The authors hypothesize that annual reproduction in some females is a result of the year-round activity of *S. miliarius* in central Florida.

BIOLOGY OF AN ISLAND PIT VIPER

M. R. Duarte et al. [Studies on Neotropical Fauna and Environment 30(1):1-13] examined the biology of the pitviper *Bothrops insularis*, an endemic snake on Queimada Grande Island, in southeastern Brazil. Since the species description by Amaral in 1921 no intensive studies have been undertaken, although hundreds of specimens have been collected for venom research, and to study the sexually abnormal females that occur in this population with some regularity. Many females in this population have hemipenes, which these authors and others have attributed to excessive inbreeding, and the population shows declining fertility. Successive human activities including brush fires and extensive collecting have apparently resulted in a threat to the survival of the species. The snakes feed mostly on birds, and occasionally lizards, and cannibalism has been reported. Mating is known to occur in August and September; birth is known to occur in February; litter sizes of 3–16 have been reported.

THE LIFE OF A CREVICE-DWELLING GECKO

P. Doughty and R. Shine [1995, Herpetologica 51(2):193-201] report on the natural history of *Phyllurus platurus,* the southern leaf-tailed geckos, which are large (100 mm SVL), nocturnal, saxicolous lizards endemic to the Sydney Basin in southeastern Australia. Hatchlings are large (33–41 mm SVL) relative to maternal body size. Females mature at larger sizes than do males, and attain larger mean and maximum adult sizes. Abdomens of adult females are thicker; this is particularly true of gravid females, and may limit their access to the narrow crevices in which they live. Adult males have enlarged testes throughout the year; adult females' reproductive cycles are highly seasonal with ovulation in spring, and oviposition in summer. Some females may produce more than one clutch (of two eggs) per year. Large nocturnal insects are consumed, and feeding occurs in all seasons.

GARTER SNAKES LEARN ABOUT NOXIOUS PREY

T. D. Terrick et al. [1995, Animal Behavior 49:857-866] examined the relative importance of visual and chemosensory information in learned aversions to noxious prey in the garter snake *Thamnophis radix*. The garter snakes were offered two different types of prey (fish and earthworms) on forceps with varying color patterns. Experimental subjects received injections of LiCl to induce immediate illness following the consumption of fish offered on either aposematic (yellow and black) or nonaposematic (green) forceps. Following their induced illness, snakes within both treatment groups showed significant aversions to fish, and avoided fish regardless of the color of the forceps with which fish were offered. However, the aversion to fish was markedly stronger among snakes in the aposematic group; aversions to unpalatable prey are formed more readily if the prey is conspicuously colored, even though recognition of unpalatable prey depends on the prey's chemosensory characteristics rather than its coloration. Future responses to unpalatable prey are therefore influenced by an unexpected complex interaction of visual and chemosensory information acquired during the initial encounter.

CARNIVORE–OMNIVORE MORPHS IN SPADEFOOT TADPOLES

D. W. Pfennig [1992, Evolution 46(5):1408-1420] reports that larvae of New Mexico spadefoot toads, *Scaphiopus multiplicatus*, often occur in two forms in the same pond: a large, rapidly developing carnivorous morph and a smaller, more slowly developing omnivorous morph. Previous studies reveal that carnivores can be induced by feeding tadpoles live fairy shrimp and that morph determination is reversible. Field and laboratory experiments indicate that the ability of an individual to become a carnivore or an omnivore is maintained evolutionarily as a response to variability in pond longevity and food abundance. Carnivores survived better in highly ephemeral artificial ponds, because they developed faster. Omnivores survived better in longer-duration artificial ponds, because their larger fat reserves enhanced postmetamorphic survival. The two morphs also occupy different trophic niches. Experimental manipulations of morph frequency in ponds of intermediate duration revealed that increased competition for food among individuals of the more common morph made the rarer form more successful. Morph frequency within each pond was stabilized at an equilibrium by frequency-dependent morph reversal, which reflected frequency-dependent natural selection on size at metamorphosis: large metamorphs had higher survival, and individuals reared at a frequency above the pond's equilibrium frequency were smaller at metamorphosis than were individuals of that morph reared at a frequency below the pond's equilibrium. Because neighboring ponds often differed in pond longevity and food abundance, each pond possessed a unique equilibrium morph frequency. This implies that morph determination in *Scaphiopus* is a locally adjusted evolutionarily stable strategy.

FILE SNAKES: HUMAN USE AND BIOLOGY

R. Shine et al. [1995, J. Herpetology 29(3):352-360] measured and dissected file snakes, *Acrochordus javanicus*, collected for the commercial skin trade in southern Sumatra for information on morphology and reproductive biology. Locally this snake is known as the karung. The karung is similar to the Australian *A. arafurae*, but has a heavier, more bulky body which has twice the mass at the same body length. Larger karung females produced larger litters, with two-thirds of the adult females in the sample reproductive. The snakes were caught by fishermen at night on unattended lines. Most of the snakes examined had embedded fish hooks in their stomachs; thus the snakes are taken as a secondary catch, and not specifically targeted by the fishermen. The lack of ventral scales in this snake and the bulky body makes the usable skin very wide and desirable for leather, but the price paid for the skins is very low, and many snakes caught on lines are discarded. The authors feel that this species is not threatened by commerce because it is aquatic and much of its habitat is impenetrable. The water is high in the habitat year-round, the snakes are not concentrated into a small area, and no specific trapping methods or hunting techniques are available to harvest the snakes.

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For sale: reptile cage, 3′L × 2′W × 2′H, wood with sliding glass door, like-new stand, $90; three stacking cages, 36″ × 18″ × 18″, wood with front sliding glass doors and stand, like new, $150; 2′ Neodesha cage, with tempered glass, new, $30. (708) 361-5835.

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For sale: alligator snapping turtle, approx. 7½″ across carapace, $75 [permit required in IL]; adult leopard geckos, 1994 c.b. hatchlings (some laid eggs this year), $35–40 each; baby leopard geckos, 1995 c.b. hatchlings, $20–25 each. Ron Winfrey, 1440 Knapp Street NE, Grand Rapids MI 49505, (616) 363-9276.

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For sale: five male and four female Deckert's rat snakes, c.b. August '95, $45 each; two adult Irian Jaya blue-tongue skinks, long term imports, $200 each. Jim Kavney, (305) 664-2881. [FL]

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For sale: Dumeril's ground boas (*Acrantophis dumerili*), $300 each; Bahia de Los Angeles rosy boas (*Lichanura trivirgata saslowi*), absolutely beautiful cinnamon and gray, $125 each; Kenyan sand boas (*Eryx colubrinus loveridgei*), possible anerythristic heteros, $50 each; black kingsnakes, babies and subadults; desert phase Cal kings, babies and subadults; male White's treefrog, $20. Contact Giovanni @ The Bean Farm, (206) 861-7964.

For sale: captive-bred snakes. Blood pythons, Burmese pythons, Kenyan sand boas, black rat snakes, bull snakes. Will deliver in Chicago metro area or ship from O'Hare Airport. Joan Moore, (312) 528-4631.

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Software: **TRACS**™—Total Reptile and Amphibian Control System. The most complete database and reporting solution for automating your breeding records. Perfect for hobbyists, commercial breeders and institutions. Only $129 plus $5 shipping & handling ($10 outside U.S). Demo disks available for $10 (cost may be applied toward purchase price). IBM PCs and compatibles. For more information or ordering contact Marcia Rybak at Leapin' Lizards, 736 N. Western Avenue, #315, Lake Forest IL 60045, (708) 735-8205 phone or (708) 735-8206 fax.

Tours: Five-day South Carolina herp and fossil tours, April–November 1995. Mini expeditions in search of 30-million-year-old turtles and crocodilians; living reptile hunts (vipers, king and rat snakes, turtles, anoles, broadhead and five-lined skinks, treefrogs and other amphibians), exotic reptile shopping and camping in a black water swamp forest. Finest Charleston hotels beginning and end of each tour. Twelve people per tour. Family plans available. $489. For reservations call Steve Faust, (800) 894-TOUR.

Tours: Custom-designed tours to Costa Rica, Panama, Belize and Guatemala. Expeditions to fit the specialized needs of herpers, photographers, educators, writers, professionals in search of data, and travelers just interested in visiting these countries (with or without their families). From $649. Steve Faust, (800) 894-TOUR.

Tours: **Road-riding in Costa Rica!** Treat yourself to the trip of a lifetime! Learn about tropical herps, find them, photograph them, see where they live. **Greentracks, Inc.**, offers the best herpetological tours led by internationally acclaimed herpetologists and herpetoculturists. See the Amazon, visit cloud forests, experience the world's greatest rainforest, super sunsets and good company. Call (800) 9-MONKEY.

Advertisements (cont'd)

Tours: Limited bookings available for guided tours of herpetological collection sites in Nevada. Call or fax (702) 471-0240 for reservations. For a brochure send SASE to: CRC, P.O. Box 0731, Las Vegas NV 89125-0731.

Video: two-hour video features the basic aspects of iguana care as taught by a professional veterinary assistant and herpetoculturist with over 15 years of experience with reptiles. Send $19.95, includes S/H, to: Edward Craft, 511 Humes Avenue, Huntsville AL 35801.

Video: *Rattlesnake Hunting*, a 60-minute video by a 30-year veteran collector. Don't miss this one! It's as close to being in the field as you can get. (Not a slick commercial production.) Send check or money order for $19.95 plus $3 postage & handling to: D. Wheeler, 2705 Sunset Trail, Riverwoods IL 60015. Allow 4–6 weeks for delivery.

Wanted: dealers of captive-bred reptiles and/or reptile supplies for the South Florida Reptile Shows, 9 AM – 5 PM, 12/16/95, Red Carpet Inn, Ft. Lauderdale FL, (305) 987-1501 phone/fax.

Wanted: adult male Egyptian tortoise, *Testudo kleinmanni*. Colin, (312) 784-2061.

Wanted: adult female coastal plains milksnake(s). Prefer Calvert County specimens. Also albino garter snakes. Scott, (919) 848-2376. [NC]

Wanted: adult male Malaysian blood python for romantic encounter with recently widowed female of same. Deep red color preferred, but beauty is only scale deep. Call Sue after 6 P. M., leave message with specifics, (607) 264-3441. [Springfield Center NY]

Wanted: male yellow-tailed cribo (*Drymarchon c. corais*), preferably long-term captive. Gary Gaziano, daytime toll free (800) 603-7500, evenings (510) 351-0607. [Castro Valley CA]

Wanted: two female Hermann's tortoises (*Testudo hermanni*). Lynn Dickason, (918) 742-3449 home, or (918) 747-7523 work.

Wanted: female *Varanus timorensis*, female *V. beccarii*, *Shinisaurus*. Mike, (770) 987-3933. [GA]

Wanted: *Uromastyx acanthinurus*. (817) 613-1242 (6 – 9 P.M. Central Time). [TX]

Wanted: Styrofoam boxes, any size or shape so long as they're not flimsy, preferably with cardboard liners, willing to pay from $2 to $5. Bring to CHS meetings. Scott J. Michaels, D.V.M, Serpent City, (815) 363-0290.

Line ads in this publication are run free for CHS members — $2 per line for nonmembers. Any ad may be refused at the discretion of the Editor. Submit ads to: Michael Dloogatch, 6048 N. Lawndale Avenue, Chicago IL 60659, (312) 588-0728 evening telephone or (312) 782-2868 fax.

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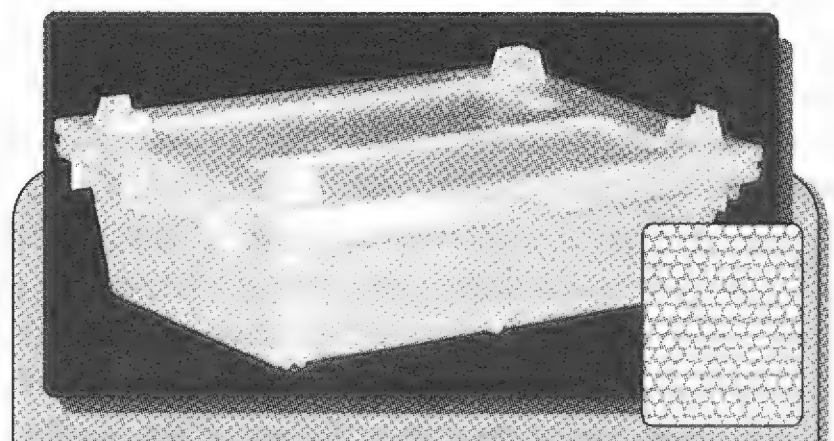

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Unofficial Minutes of the CHS Board Meeting, October 13, 1995

The meeting was called to order at 8:11 P.M. Board member Brian Jones was absent.

Officers' Reports:

The Minutes of the September board meeting were read and approved. The Treasurer's Report was read and accepted.

Membership: The CHS will run out of Care-in-Captivity books in four to five months. Mike Dloogatch will find out exactly how many we have left. We are also running out of Membership Lists. John Driscoll suggested printing fewer copies of the list more frequently, so that members wishing to purchase Membership List will get a more up-to-date version.

Committee Reports:

1996 Expo: Jill Horwich moved and Nicole Marrello seconded that the CHS allocate $500 to reserve space at Triton College for the 1996 Expo, tentatively scheduled for Memorial Day weekend. The motion passed unanimously.

Shows: The Chicago Academy of Sciences show was a big success for both the CHS and the CAS. The CHS has agreed to participate in the next Chicagoland Family Pet Show at Arlington Park, to take place in March 1996. We will have the same booth space and location as we had in 1995.

1995 Midwest Symposium: There was an extensive discussion regarding last-minute details for the upcoming Midwest Herpetological Conference. A meeting was scheduled at the home of Jill Horwich to prepare the information packets for the conference attendees.

Library: The CHS library is missing 75 books. Librarian Jenny Picciola will send out a form letter to solicit the return of the missing books.

Grants: Tony Rattin proposed that the CHS increase its funding of Grants in Herpetology. He distributed a number of hand-outs in support of this proposal. A discussion was held regarding the hand-outs as well as various options for funding the grants. Joan Moore suggested that the CHS allocate money to the grants program based on a fixed percentage of income per year. Marcia Rybak suggested the solicitation of funds from businesses involved in herpetology. Jack Schoenfelder will compile and provide financial information for the next board meeting.

Adoptions: Char Haguewood is resigning as adoption chairperson effective December 31, 1995. Anyone wishing to assume this responsibility should contact Marcia Rybak. Joan Moore stated the CHS owes Char a big thank-you for all her hard work in this area.

Old Business:

Trailer: The CHS did not rent a trailer for use at the CHS show. Ron Humbert did obtain the diagonal measurement from the upper right-hand corner to the lower left-hand corner of the 6 × 8′ trailer. That measurement is 176″. The trailer can be purchased for $1,650.00.

Russian tortoises: Ron Humbert reported that 2900 Russian tortoises have arrived in California and are being held by Walter Allen and his affiliates. Ron Humbert is waiting to hear from Mr. Allen regarding the shipment to Chicago of our group of tortoises, and will advise the new owners when he has any information.

IL DOA: Mike Dloogatch spoke with Dr. David Bromwell regarding the types of books he would find helpful, and came up with several suggestions. Jack Schoenfelder moved and John Driscoll seconded that the CHS allocate $50.00 to purchase a book to be selected by Mike Dloogatch from the CHS book store to send to Dr. Bromwell. We will also send a booklist in which other suggested titles are marked. The motion passed unanimously.

New Business:

Amphibian group: David Goode is interested in starting a special interest group for CHS members interested in amphibians. He already has 25 potential members, and would like to hold the meetings at Emily Oaks Nature Center in Skokie, Illinois. Marcia Rybak will send a copy of the CHS guidelines for special interest groups to David Goode, and the board wishes the new group well.

Round Table:

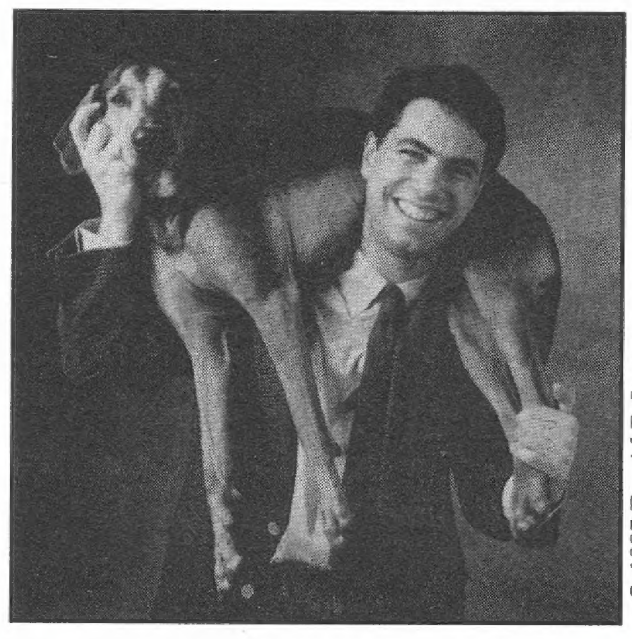
Jack Schoenfelder informed the board that he had filed the annual report for the CHS on time. Thank you to Jack.

The meeting adjourned at 10:13 P.M.

Respectfully submitted by the Recording Secretary, Jill Horwich

Pets & Pet People

photographed exclusively in black & white



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HERPET-POURRI BACK NEXT MONTH

Ellin Beltz has taken a one-month furlough from her duties as HerPET-POURRI columnist. Ellin hopes asks her loyal contributors to continue sending items of herpetological interest and promises to resume her column in December.

THIRD WORLD CONGRESS OF HERPETOLOGY

The Third World Congress of Herpetology will take place 2–10 August 1997 in Prague, Czech Republic. The Congress will feature both scientific and social events. Until 1 February 1997 the registration fee is roughly $350 ($230 for students). For information and a preliminary registration form, write to Third World Congress of Herpetology, c/o Czech Medical Association, J. E. Purkyně, Congress Department, P.O. Box 88, Sokolská 31, 120 26 Praha 2, Czech Republic. Fax: (++42 2) 29 46 10 or (++42 2) 24 21 68 36.

WISCONSIN AMPHIBIAN EGG KEY AVAILABLE

The Wisconsin Department of Natural Resources recently published "A Key to the Eggs of Wisconsin's Amphibians" as Report 165 in its *Research Report* series. The report, by Dreux J. Watermolen, discusses characteristics of amphibian eggs and provides a key to the 19 species found in Wisconsin. Photographs of seven species by Gary S. Casper, James H. Harding and William B. Preston accompany the key. Copies of the key are available from Dreux Watermolen at the Wisconsin Department of Natural Resources, P.O. Box 7921, Madison, WI 53707-7921 or at waterd.state.wi.us over the Internet.

CONSERVATION OF WISCONSIN'S COLD-BLOODED ANIMALS CONFERENCE

The third "Conservation of Wisconsin's Cold-blooded Animals" conference will be held on March 2, 1996, at the Radisson Inn in LaCrosse, Wisconsin. The conference, which is sponsored by the Wisconsin Department of Natural Resources, the Wisconsin Chapter of the Wildlife Society, and the University of Wisconsin Natural History Museums Council, will feature talks and posters covering identification, life history, management, and conservation of amphibians, reptiles, non-game fishes, insects, and other invertebrates.

The conference planning committee is extending a call for papers for presentations and posters dealing with Wisconsin's cold-blooded species. Abstracts are due by December 15, 1995.

For additional information or complete instructions for submitting abstracts contact Dreux Watermolen at the Wisconsin Department of Natural Resources, P.O. Box 7921, Madison, WI 53707-7921, at waterd.state.wi.us over the internet, or at (608) 266-8931 by telephone.

1996 MIDWEST HERPETOLOGICAL SYMPOSIUM

The Midwest Herpetological Symposium will be hosted by the St. Louis Herpetological Society next year. The date to reserve is the weekend of October 18–20, 1996. The location is the Holiday Inn – Airport North, 4545 N. Lindbergh Boulevard, St. Louis, Missouri. The symposium will include a Breeder's Exposition and Sale on Friday night and a Saturday night banquet and auction. Registration details will appear in the *Bulletin* as soon as they become available.

INTERNATIONAL HYLID SOCIETY

The International Hylid Society is a new organization dedicated to treefrog enthusiasts worldwide. Membership is open to anyone with an interest in treefrogs. The focus of the organization is on treefrogs; not just those of the family Hylidae, but any of the many treefrog species throughout the world. Members will receive *The Bulletin of the International Hylid Society* on a quarterly basis. This will contain articles on a variety of topics, and will include classified ads (free to members), a directory of breeders, and full-color photos. The first issue will be published Jan/Feb 1996. Articles, photographs and classified ads are now being accepted. Membership is $15 per calendar year. If you want your name to appear in the breeder directory (available to members only) along with the species you work with, please include the scientific names of those species. Make check or money order payable in U.S. funds to the International Hylid Society and send it with your mailing address to: William Brown, c/o Amphibian Conservation and Research Center, 1423 Alabama Street, Lafayette IN 47905, U.S.A. For more information write William Brown at the above address or call him at (317) 742-7331, or E-mail 102436.2415@compuserve.com.

UPCOMING MEETINGS

The next meeting of the Chicago Herpetological Society will be held at 7:30 P.M., Wednesday, November 29, at the Field Museum of Natural History, Roosevelt Road at Lake Shore Drive, in Chicago. The annual election of officers and members-at-large of the CHS Board of Directors will take place at this meeting. During the intervals while ballots are being tallied, members are invited to show their 35 mm slides. The slides should be herp-related and each member's presentation must last no longer than 10 minutes. Those who are interested in showing slides are asked to arrive early so that their slides can be placed into trays.

December's speaker will be Robert Henderson, Curator of Herpetology at the Milwaukee Public Museum, who will present a program on New World boas. In January, the speakers will be Special Agent David Kirkby from the U.S. Fish & Wildlife Service, and Officer Sheila O'Connor from the Illinois Department of Conservation. They will provide an overview of legislation concerning herps and will be available to answer questions from the audience.

We are required to use the entrance on the west side of the museum. We have permission to use the staff parking lot to the west of the museum. Entrance to this lot is from McFetridge Drive, the wide street just to the south, between the museum and Soldier Field. There is also free parking available in the lot to the north of the museum. The #146 CTA bus goes directly to the museum. Unfortunately, it does not operate after 9:00 P.M. However, after the program anyone needing a ride to a CTA stop will have no trouble finding one—just ask any board member.

Turtle Club

The Chicago Turtle Club will meet Sunday, November 26, 1:00–3:30 P.M., at the North Park Village Nature Center, 5801 N. Pulaski, in Chicago.

INDIANA SYMPOSIUM IN HONOR OF DR. SHERMAN A. MINTON, JR.

The Indiana Academy of Sciences is sponsoring a symposium in honor of **Sherman A. Minton, Jr.**, on the occasion of the publication of his revision of *Amphibians and Reptiles of Indiana*. The symposium will be held 12–14 April 1996 in Indianapolis at the Indiana University / Purdue University Conference Center. Dr. Minton is well known for his work on venomous reptiles, the reptiles of Pakistan, the regional herpetology of the Midwest, and popular books on herpetology.

The symposium will include a Friday evening dinner featuring **Whit Gibbons** as the after dinner speaker. The morning program on Saturday will focus on the career of Dr. Minton, with talks by **Carl Gans** (Minton's work on the reptiles of Pakistan), **David Hardy** (pitviper bites), **Bernard Bechtel** (abnormalities in reptiles) and **Harold Voris** (venomous sea snakes). The afternoon session will deal with "Hoosier Herpetology" and the publication of Minton's revision of his classic monograph on the herpetofauna of Indiana; biologists working on the amphibians and reptiles of Indiana will present brief overviews of their research and provide a perspective on herpetological research in Indiana today. On Sunday there will be optional field trips.

For registration information, contact: Harriet A. Rodenberg (Minton Conference), University Place, Conference Center and Hotel, 850 W. Michigan Street, Indianapolis IN 46202-5198, USA. Telephone: (317) 274-5053; fax: (317) 274-5053; e-mail: hrodenbe@indycms.iupui.edu

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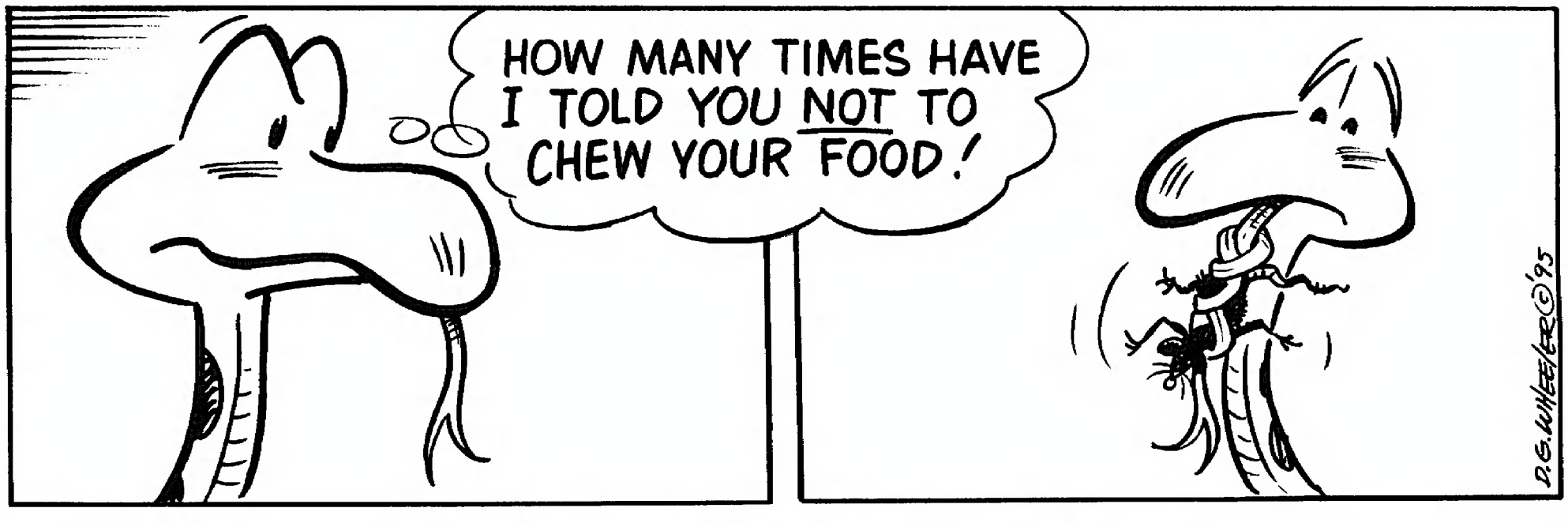

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